Weatherwise

Schools Issue

Volume 7, Number 5 **October 1954**

"SOME PEOPLE ARE WEATHERWISE BUT MOST ARE OTHERWISE"—BENJAMIN FRANKLIN

WEATHERWISE

THE MAGAZINE ABOUT WEATHER

DAVID M. LUDLUM, *Editor* HENRY W. BULKLEY, *Associate Editor*

The AMS and Education

THE American Meteorological Society was founded in 1919 with the expressed objective: the advancement and diffusion of knowledge of meteorology. At the organization meeting of the Society a Committee on Meteorological Instruction was established. Educators, of course, have played a leading role in all Society activities.

At the present time there are two committees of the AMS devoted to the field of learning. The Advisory Committee on Education is headed by Prof. Phil E. Church, University of Washington, Seattle, and its membership is made up of representatives of the leading universities which conduct departments of meteorology.

A new Committee on Secondary School Education was created early in 1954 at the instance of President Merewether. The temporary chairman is David M. Ludlum, Franklin Institute, Philadelphia. The other members are Dr. Vincent Schaefer, Munitalp Foundation, New York City, and Ethan A. Murphy, Mass. Institute of Technology.

The first project of this committee is the present "Schools Issue" of *Weatherwise*. It is hoped that this will make a start in filling the lack of guidance material for high school teachers who wish either to conduct a course in meteorology or to carry on a club or extra-curricular activity in weather study. The committee has other projects under consideration: (1) a national essay contest on a meteorological subject with scholarships for university study in meteorology as prizes; (2) the distribution of a career opportunity pamphlet to guidance counselors in both secondary and collegiate institutions; (3) the writing and publication of an integrated series of pamphlets and textbooks on meteorology and climatology for use in schools for group study and for home study by individuals, regardless of age or scientific sophistication.

The Schools Issue of *Weatherwise* will be mailed to 27,500 junior and senior high schools, private and parochial schools. All who may read its columns and who have problems that either of the above committees might help solve are requested to communicate with the committee members or to write the Executive Secretary of the AMS, 3 Joy Street, Boston 8, Mass.

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Front cover: Miss Ann Slattery, a pioneer in meteorological education, and student at Malden High School, Massachusetts.

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Meteorology in Our Secondary Schools

ARTHUR F. MEREWETHER, *President, American Meteorological Society*

WHAT do fish know about water? They probably do not go in schools to learn about it, but if you have ever gone fishing you realize a fish knows something about his environment.

What has that got to do with secondary school education and meteorology? Well, like fishes that live in water, people live all their lives in this ocean of atmosphere; but unlike fishes, the vast majority of them know little or nothing about the environment in which they will spend their entire lives—and which so vitally affects so many things they do, or don't do.

In our educational system today, it is estimated that about 4,800,000 students enter primary school each year. Of these, 50 per cent will graduate from high school and about 10 per cent from college. Each year about one hundred of our colleges give some sort of weather course to a few thousand students; only about 300 students get degrees in meteorology. Little or no instruction, worthy of the name, is given in meteorology in most of our secondary schools.

Admittedly our educational system has a great problem in determining what subjects to teach. Our secondary schools must prepare students to meet specific college entrance requirements, or they must prepare them to go to work and to earn a living. In neither case is an understanding of weather required. But our schools also have the responsibility of preparing their students for life. And there's the rub, for all our lives are lived immersed in weather.

Some indication of the interest and importance of weather may be gained by the number and frequency of radio and television weather programs. But at the same time the lack of understanding of even the simplest weather processes by the vast American audience can be measured by the poor quality of many of these programs, particularly those on television. This is simply because audience and commentator alike have not the slightest conception of what makes weather.

We meteorologists think it is time that this situation should be corrected, and we believe it can be corrected by including a course in meteorology in the secondary school curriculum, or at least by emphasizing this subject far more than is done today. Courses are now given in such subjects as biology, botany, Latin, French, chemistry. This is all well and good, and such courses are valuable and sometimes may be essential to some students' later careers. Nevertheless, we venture to say that most adults today who are high school graduates would get more out of life had they had a course in meteorology than they do for having had courses in the familiar subjects mentioned above.

Heat waves, blizzards, droughts, floods, hurricanes, tornadoes, air pollution, pitted windshields, atomic explosions, artificial rain making, and so on, vitally affect us all and are therefore of great interest to us. But even if for no other reason than that an intelligent person should have some conception of the world in which he lives, of the vast natural forces that operate around him, he should have the opportunity to take a meteorology course in high school.

And, last but not least, many a youngster exposed to meterorology in high school may become sufficiently interested to continue his meteorology training in college. What better way is there to keep this a thriving field? It must be kept thriving to keep pace with the rapid advances taking place in other fields of science, aviation, atomic energy, yes, even space flight. The educational base in meteorology must be broadened to include the secondary schools.

What Is Meteorology?

THOMAS MALONE, *Massachusetts Institute of Technology*

THE atmosphere was man's first scientific laboratory—one in which he could watch on a grand scale a complex of processes involving most of nature's fundamental laws. Meteorology is the science which deals with that atmosphere. Its aim—as yet unrealized—is a complete understanding of the physical processes which combine to produce the collective phenomena we know as "the weather." Weather forecasting is the most obvious application of this knowledge to the problem of predicting the future state of a complicated hydrodynamical and thermodynamical system from an observed initial state. The importance of accurate forecasts to an almost limitless catalogue of human activities has served as a stimulus to the basic scientific research into the workings of the atmosphere.

But meteorologists are concerned with a much wider variety of topics, ranging from a study of photochemical processes in the outer reaches of the atmosphere to the effect of rainfall on the underground water supply. Their activities usually fall into one or more of the major subdivisions of the field: physical meteorology, dynamic meteorology, synoptic meteorology, climatology, instrumentation, and applied meteorology.

The physical meteorologist studies the chemical composition of the atmosphere, and the laws of radiation, absorption, and scattering which are of importance in the transformation of solar energy into the kinetic energy of air moving over the surface of the earth. He is concerned with the optical, acoustical, and electrical properties of the atmosphere and worries about such things as how the separation of charges sufficient to cause lightning is produced. The physical meteorologist investigates the nature of the processes by which water vapor is transformed into the liquid and solid states and the mechanism by which billions of tiny cloud droplets combine to produce the millions of much larger raindrops which fall to the ground as rain.

The dynamic meteorologist is concerned with the solution of the complicated equations of hydrodynamics and thermodynamics which apply to a spectrum of atmospheric motions ranging from the huge circumpolar vortex, operating on a global scale, to the small turbulent eddies which characterize the plume of smoke escaping from a chimney. The perversity of these equations has not permitted an exact analytical solution, but the development of high-speed electronic computers provides a beacon of hope on the horizon.

To the synoptic meteorologist falls the task of coordinating hundreds of weather observations, taken at the ground and aloft all over the world, into a coherent picture of the day-by-day weather. It is he who charts the movements of centers of high and of low pressure, of air masses and fronts, of hurricanes and tornadoes. It is he who is daily confronted with one of the most difficult tasks of modern science—the prediction of the weather for tomorrow, for next week, or for next month from insufficient observations and with the added handicap of incomplete knowledge.

The climatologist is interested in marshalling and analyzing the accumulated weather records of past years to provide a description of the things we call "the climate." In a broad sense his task is not merely one of tabulating and filing data which describe the temperature, pressure, humidity, wind, rain-

fall, sunshine, etc. He also seeks an answer to the question, "Why the weather?", and hence, "Why the climate which is simply the summation of all the weather?" Moreover, his field of inquiry extends to cover the changes in the climate over decades, centuries, thousands, and millions of years.

The specialist in instrumentation is the measurer, indeed, of every conceivable characteristic of the atmosphere. The size and number of droplets in a cloud, the amount of solar energy received on a unit surface at the ground, the base and top of cloud decks as revealed by radar, the pressure, temperature and humidity miles above the surface of the earth, or the turbulent fluctuations of air motion a few centimeters above the ground . . . all these are the measurements which his instruments must make.

Applied meteorology, or engineering meteorology as it is sometimes called, is now emerging as a major, and sometimes astonishing, subdivision of the field. Here the emphasis is on determining the relationship between weather on the one hand and merchandising, manufacturing, public utility operation, construction, architectural design, plant location and operation, biological processes, and a whole litany of human activities on the other hand, and then doing something about this relationship. The economic importance of weather to many aspects of business and industry is obvious, but only recently has the matter been given serious study. The "weather factor" was forcibly impressed on the military men during World War II when they were faced with the operation of the largest "business" or "industry" imaginable. By the end of the War the weather factor was taken into consideration in practically all military activities, whether it was the design of a new weapon, the location of an airfield or other installation, the clothing and feeding of troops, an assault on an island or the relative effectiveness of fire bombing versus high explosive bombing against Japan. Now private industry and business are coming to realize that the "weather factor" is susceptible to the methods of operations research and no longer need be regarded as an Act of God. This healthy attitude is opening up highly interesting and rewarding careers for meterologists with a background in science, engineering, and business administration.

The activities enumerated above can no more than give a hint at the wide scope of interests which may occupy the attention of the meteorologist. One characteristic of special interest is shared in common by all these fields: the student quickly finds himself at the frontiers of knowledge, confronted with an array of challenging scientific problems. Intelligence, curiosity, and a solid foundation in the basic tools of scientific inquiry are all that are needed to achieve the satisfaction of contributing the needed answers.

Courtesy of Chicago, Milwaukee, St. Paul & Pacific R. R.

A Weather Course in Malden High School

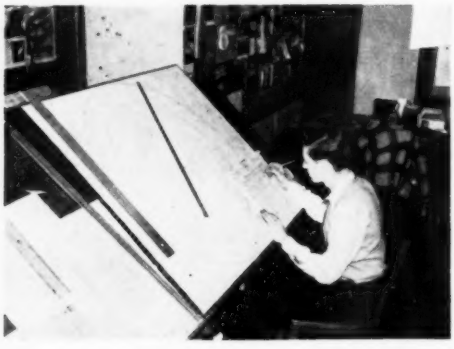
BRUCE GILCHRIST, *Science Dept., Malden H. S.*

WEATHER can be fun. Weather can be useful and practical. That is what the pupils of Malden High School of Malden, Massachusetts, say about their course in meteorology. Their school is one of the few in the world on the secondary level to give a full year course in meteorology. The course is particularly popular with those boys who want to work at some speciality in the military services.

The weather course was begun during World War II when the government was anxious to give boys in their late teens as much practical training as possible previous to their induction into the armed services. Miss Anne Slattery, a dynamic history teacher, volunteered to teach those pupils who were interested. Owing to her boundless energy and enthusiasm, the course grew in popularity and usefulness. Many of the boys taking weather became so interested that they went into it as a life's work. Two years ago Miss Slattery retired and her place was filled by Bruce Gilchrist, a teacher with no previous training in meteorology but with a general background in the physical sciences. Under his leadership the course has been broadened and made to include a sound training in mathematics.

Malden High School is very fortunate in its physical setup. The school is a good looking, modern, three story building in the center of the city. On the roof is a two room pent house. This is the location of the Malden High Weather Bureau. In one of the two rooms the regular classes are conducted each day. There are two meteorology classes per day composed chiefly of junior boys in the general course and one class in aeronautics made up entirely of senior general boys. The other room has been fixed up as a weather bureau. Here are kept the charts and maps and the room contains an office desk, a large drafting table, and chart racks. In one corner are a short wave radio and the indicating panel of the weather vane and anemometer. In another corner of the room are two work benches used for working on projects. These concern chiefly the building of home made weather equipment. On the roof of the pent house is the usual instrument shelter which houses a maximum thermometer and a hygrothermograph.

As in any class in any school, some students are more interested in the work than others. Some of those taking meteorology are interested in a general background in science, others want just another point toward graduation. The regular class work provides for these people. Still others are interested in meteorology for its own sake. The best of whom are organized as the Malden High School Weather Bureau. Each morning they go up on the roof to take the readings and observations and to listen to the reports from Logan International Airport. These reports are displayed in the classroom so that regular classes may make use of them.



Also a heavy steel tower has been erected on the roof and from it the Weather Bureau displays its flags predicting the weather each day during the school year.

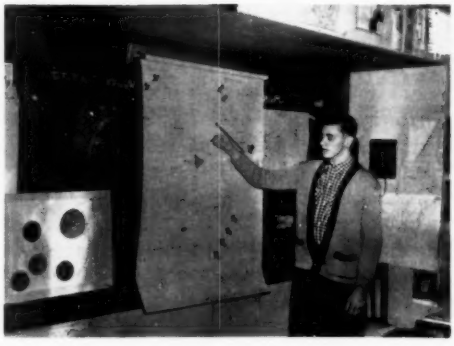
Meteorology in Malden High School is of interest chiefly to those who wish to have a speciality to work at during the inevitable stretch in the Armed Services which all young men face today. Malden High has placed about forty-five of its graduates in the weather work of the Air Force, Army, and Navy. About two-thirds of these boys served or are serving with the Air Force as this branch of the services offers more opportunities and has more need of weather men. At the Weather School at Chanute Air Force Base in Illinois, Malden High graduates seem to rate right at the top of each class.

Instructor Gilchrist also teaches a class in aeronautics to the senior general course boys in the same room. This course attempts to give a general survey of the whole field and to point out different lines of work that might be of interest to boys enlisting in the Air Force. The last month of the course is devoted to meteorology and its application to flying. The combination of meteorology in the junior year and aeronautics in the senior year is a good one for any boy considering enlistment in the Air Force. A good number of boys each year, realizing the advantage this training gives them, enroll in Air National Guard or the Coast Guard reserve and go into meteorology while still in the reserves. The air reserves meet at Logan Airport in East Boston on Tuesday nights and all day Sundays. Two-thirds of the meteorology unit at Logan at the present time is composed of Malden High School boys or recent graduates. Since the reserves are limited to boys over seventeen, steps are being taken to get the boys started a little earlier by interesting them in the local Civil Patrol unit while they are still sophomores. Pupils who see the value of what they are studying in school are willing and anxious to learn.

A few girls in the commercial course each year take meteorology and aeronautics. Some of these plan to become air line hostesses, others are employed after graduation as clerks by the meteorology department at Massachusetts Institute of Technology. This school is glad to obtain girls with technical vocabulary and background to do their work intelligently.

Malden is fortunate in being near places that can be used for valuable field trips. Besides M.I.T. with its vast radar setup, there are Logan Airport and Hanscom Air Force Base at Bedford. Trips are also taken each year to the famous Mt. Washington Observatory, to the Blue Hill Observatory at Milton, and to the Naval Air Stations at Brunswick, Maine, and So. Weymouth, Mass.

Although greatly pleased with the benefits the community and the students have derived from the meteorology course, instructor Gilchrist is not completely satisfied. He would like the course to be accepted for college entrance and to be taken by boys in the college preparation course. With M.I.T. so near, Malden High School should be feeding in a number of its best students to take up meteorological training in that great institution.



A Meteorology Course in Phoenix Union High School

JAMES R. WILSON, *Phoenix Union High School, Arizona*

THE subject of meteorology in Phoenix Union High School is a "war baby." Like Topsy 'it wasn't born—it just growed.' Back in the early 1940s the War Department asked the secondary schools of the country to teach meteorology. We did our duty in Phoenix Union. There was no suitable textbook, so several professors at Columbia University hurriedly wrote one, but, of necessity, it covered the whole field of elementary aviation with only a section on meteorology. It was a fine job, and we instituted the course in our physics department. It lasted just one year as a single course, being so voluminous that both teachers and students became discouraged trying to handle all the material as a single course in one year. The result was the creation of three separate courses, two in aviation and one in meteorology. It fell to our lot to teach the meteorology in our physiography department, and all three courses were incorporated into our Technical High School curriculum.

For three years we taught meteorology as a single one-semester course, and Dr. R. J. Hannelly did likewise at Phoenix College for the aviation cadets. *Meteorology for Pilots* by Benarthur Haynes was used for basic information, but the thing that saved us from presenting purely a lecture course was a now out-of-print work book. We had been teaching three chapters in physiography dealing with weather and climate for many years and had gradually installed a number of meteorological instruments such as a barograph, thermograph, anemometer, and rain gauge, so we were ready to go to work.

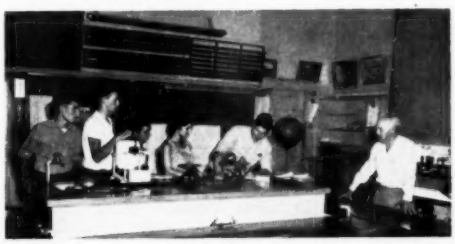
It was still rather difficult to teach the subject in high school without a textbook written expressly for the secondary vocabulary level and designed after the general pattern of high school teaching. After three years struggle, Dr. Hannelly and I became a bit 'fed up' with the job we were doing, so we sat down in the summer of 1945 and wrote our own text. We used this material in our high school for three more years as a text in ditto form, and in 1951 it was published. It is quite elementary, but since it is our own creation, we made the best of it. We still needed a laboratory book and tests; these the writer developed as he went along and published in final form this past spring. It looked as though we might be well set, but

let the reader remember that meteorology, instead of needing revision every few years, needs revising every few minutes.

In addition to the instruments mentioned above, we have added a recording humidity device (hygrograph), an anemometer that shows inside the velocity of the wind, a weather vane that does the same, hygrometers, sling psychrometer, max-min thermometers, mercurial barometer, indoor-outdoor thermometer, a supply of accurate Fahrenheit and centigrade thermometers for student use, and a number of lesser odd pieces. Each student in a class is required to read all of the basic instruments used in the course and to learn something of how the data are used in weather forecasting. In addition to this, certain students read these basic instruments daily and put the readings on the blackboard for all to record in their workbooks. This is done for a period of at least one month. The students also make daily forecasts from the data as a practice detail. One of the principal factors in the forecast is a study of the cloud formations at the time and their changes throughout the study period. From the daily data on the board at the end of the month, the students make graphs showing the relationships between pressure, temperature, and humidity.

There are a few phases of the laboratory work which might be mentioned. Students make their own hygrometer in the classroom and determine the relative humidity from a table in the text. They can do this later in their own homes also. They make a comparative thermometer on heavy cardboard or beaverboard to convert Fahrenheit to centigrade and vice versa. They learn by experiment and making sketches the underlying reasons and the immediate cause of our seasons, a thing which few laymen can do. And they draw a weather map from Weather Bureau data including all of the basic modern material. Some students are trained in changing the graph paper on the recording instruments, and they come in early each Monday morning to do this. In their first readings of the instruments, some students are delegated to check the rest of the class in their individual observations, and a report is turned over to the instructor when all students have read the instrument correctly. These jobs are sought by the students and serve as a strong motivating force. Likewise, students volunteer for and do a number of demonstrations each semester.

We believe that meteorology should have its place in the sun along with other science subjects, at least as a one-semester course such as ours. We have one class each semester and sometimes more. There is no other subject in the science field in which as many people are interested as weather. While people are interested in weather, most laymen know very little about it from a scientific standpoint. People are not sufficiently weather conscious to check with the Weather Bureau before venturing on a trip or on some project which may be materially affected by weather. Just a few years ago five men in Arizona lost their lives in a snow storm while hunting deer on our plateau to the north, and three others were located just in time to save their lives. This storm was publicized in advance by the local Weather Bureau. We try hard to make our students very respectful of weather changes. Learning some definite things about weather promotes such respect.



Miami Beach Meeting

The 133rd National Meeting of the AMS will take place at the Empress Hotel, 4333 Collins Avenue, Miami Beach, on 17–19 November 1954, under the sponsorship of the Miami Chapter.

Highlight of the technical sessions will be a panel discussion of research on tornadoes and severe storms. Topics for other sessions are: tropical meteorology and radar aids to meteorological research.

An elaborate program of tropical entertainment is planned. Members can obtain very nominal convention rates, and all are urged to bring their families for a Florida vacation.

Opportunities in Meteorology—A General Outlook

FRANCES ASHLEY,
Assistant to the Executive Secretary, AMS

AMONG the many rewards in pursuing a career in meteorology, three factors may be singled out to demonstrate the unique character of this field.

In the first place, meteorology is a young science which has grown up since World War II when its importance in military operations was recognized. Since a complete understanding of the physical processes of the atmosphere is not yet realized, the growing period continues and there are many young people working in the profession in response to this challenge. A survey being published this year shows that the Bureau of Labor Statistics for 1951 reported that weather personnel are the youngest of three groups of earth scientists; the median age was 34 for meteorologists, 35 for geologists, and 37 for geophysicists.

Secondly, learning about the weather is a fascinating study. While the work may involve a great deal of responsibility, the spirit of adventure is always present. Weather can be friend or foe, and thoughts now turn to possible modification and control of this valuable tool and ally, one of the numerous frontiers in scientific progress. The training, skill, and imagination needed to meet the demands of a meteorological career are discussed briefly in this article and more extensively in the "Career and Education Issue" of *Weatherwise*, October 1953.*

Thirdly, unlimited opportunities await the application of weather knowledge to the affairs of man. In branching out beyond their immediate activities through work with other sciences and with business and industry, meteorologists will materially assist in bringing the benefits of science to help all mankind. It is not too remote to think of the time when many organizations will have resident meteorologists immediately available for consultation on staff problems. Already we can look under the classified section of telephone directories in some cities for "Weather Services," just as we would seek the advice of our medical doctor, lawyer, or travel agent.

THE PROFESSIONAL METEOROLOGIST

Emphasis in all fields is continually being placed on higher education. To attain a professional position in meteorology, at least a bachelor's degree is necessary. During the last two years in a university when specialization in meteorology is begun, part-time work within the department of meteorology offers valuable, first-hand experience. Scholarships, fellowships, and assistantships are often available for financial help. Student-aid trainee programs of the U. S. Weather Bureau are offered in the summertime. It should be emphasized that those who are able to continue on to a doctoral degree in meteorology may look forward to substantially higher income levels than scientists with less advanced training.

Forecasting is the best-known activity of the meteorologist. His work is to coordinate the hundreds of weather observations, the movements of pressure systems, air masses and fronts, hurricanes and tornadoes, into the daily weather map. At a small station the job involves many duties, from observations to administration, sometimes including shift work since weather stations operate 24 hours a day. At a larger station the duties become quite specialized in dealing with aviation briefing, special storm advisories, flood forecasts, frost warnings, and forest fires conditions. Forecasting, however, is just one of the many activities of a meteorologist, but all persons during the training period become acquainted with the techniques involved in pro-

* Available without charge from the American Meteorological Society.

ducing a forecast, even though they may turn to other phases as a future career.

Instrumentation specialists are required to make the basic measurement of atmospheric properties. Meteorologists in this activity may work in the laboratory on research and development work, or enter the field for testing, installation, or, perhaps, take part in aviation reconnaissance work. The use of radar instruments in meteorology has become so vast that an entire subdivision of the science has grown up around electronic instrumentation.

Climatologists, who are usually trained in meteorology, have the advantage of working with a great mass of data already compiled and stored without worrying about tomorrow's weather. The climatologist is concerned with the whole climate of an area based on past weather patterns. Such data, to give only one example, may be used in pinpointing desirable and undesirable areas for resorts, construction of homes and industrial cities, and locating farming acreage. Hydrologists work closely with climatologists in problems of dam construction, predicting runoff of rainstorms, and controlling floods.

The interests of the research meteorologist are too numerous for complete description here. His training, usually through a master's or doctoral degree, plus needed curiosity and imagination, leads him to apply his knowledge of scientific laws and principles to problems he creates and works on independently, or to projects assigned to him and his colleagues in the research laboratory. The theoretical findings lead to better practical methods for the forecaster, instrument technician, climatologist, and hydrologist. Hundreds of subjects occupy the interest of the physical and dynamic research meteorologist such as the general circulation, layers of the atmosphere, interaction of sea and air (oceanography), turbulence, precipitation, icing, climate of other planets.

The divisions of meteorological work described above often overlap. Many other designations, such as arctic meteorologist and tropical meteorologist, illustrate the specialties that have developed.

The Nonprofessional

The work of the nonprofessional meteorologist requires a mental agility with emphasis on speed and accuracy to meet deadlines, and may require moderate physical exertion. Completion of high school education including courses in mathematics and physics beyond general science is necessary. For some positions, college work in physical sciences can be substituted for the experience requirement. In government employment additional experience will usually lead to higher initial job classification.

The nonprofessional is concerned with operation and maintenance of meteorological instruments, handling weather codes, and plotting charts and maps of surface and upper-air data. Weather observers, computers, plotters, and technicians filling nonprofessional positions in the U. S. Weather

(*Continued on page 133*)

Two industrial meteorologists at the General Electric Company study their weather charts before issuing a forecast.

Weather in Elementary and Junior High School Programs

JEFF WEST,
Supervisor Elementary Science,
Stockton, California

Our Newspaper

Today is Tuesday, December 7th
It rained this morning
This afternoon the sun is shining
This afternoon is nice and warm.

EVERYBODY talks about the weather, even first grade pupils. They write newspaper stories about weather, do simple experiments, and learn to record information in a systematic way. As children mature and progress through the grades, they acquire a great deal of functional knowledge of weather through a wide variety of experiences. They make first-hand weather observations, construct and use simple weather instruments, and extend their understanding through the use of books and audio-visual materials.

Even in the upper elementary and junior high school grades, the study of weather should be an exciting experience for boys and girls with the content adapted to the level of maturation. Teachers use a variety of techniques to bring this topic alive for their students. Most of these techniques involve activity, pupil participation in planning, and the use of a wide variety of concrete experiences.

One technique that has been used successfully by teachers is the development of three charts during the period covered by the unit of study. These three charts might be titled:

"Things We Know About Weather"
"Things We Think We Know About Weather"
"Things We Want to Know About Weather"

Boys and girls in the upper elementary and junior high school will have considerable knowledge of weather and its causes. To be sure, their concepts will be fragmentary or even faulty. The wise teacher will attempt to determine the present state of development and to build from there. An excellent way to begin is to list "Things We Know About the Weather."

The students are asked to make statements about the weather that they know to be true. The teacher can be as exacting as the maturity of the boys and girls warrants. Distinction can be made between facts that can be verified and superstition, comparison can be made of the authority-value of sources of information, and plans can be made for checking the accuracy of observations. In short, here are opportunities to work on the development of desirable scientific attitudes.

Many of the statements made by students will need to be verified by further study. These statements can be written in the second list, "Things We Think We Know About Weather." Here, too, will be the answers that boys and girls suggest to some of the problems that puzzle them. These suggested answers, or hypotheses, are essential to the problem-solving method. If the students are mature, the teacher may require that only those items be included that result from careful study of all the evidence. Other teachers believe that this list should be comprehensive and has value for the insights that it provides boys and girls into ways of collecting evidence. Individuals or groups of stu-

dents may plan experiments, or construction projects, or methods of observation, or authorities to consult in order to collect evidence to support or disprove the hypothesis. After the hypothesis is proved and checked with authoritative sources, the statement can be listed on chart number one.

The last list is for questions that have no ready answer. Everyone will need to be alert for answers to suggest for these problems. As boys and girls read, talk to people, look at films and filmstrips, and make their observations, they will have opportunities to use their information to formulate new hypotheses.

The teaching technique that has been described can be used for many topics. However, weather is especially well-adapted to its use. There is some kind of observable weather each day, weather learnings can be broken down into simple elements, and many weather understandings can be acquired through first-hand experiences.

A study of weather in elementary and junior high school grades can contribute to the major purposes of science in these grades, as well as to the growth and development of boys and girls. To help pupils to understand weather and how it affects their lives is to help them to understand better the world in which they live. In a study of weather, boys and girls can have a great deal of practice in solving meaningful problems. The cause and effect relationships that exist in weather phenomena can contribute to the security of boys and girls as they realize this is an orderly universe. Through this study, pupil interests can be broadened and new avenues of interests opened. Finally, a study of weather can help students develop mature points of view in relation to tolerance and intellectual honesty.

A Camp Weather Station

HERBERT MONTGOMERY,
New Castle, Indiana

OUR school camp provides a practical laboratory experience in observing and forecasting the weather, thus creating a "learning by doing" situation that is most effective in any type of education. During the early elementary grades the pupils have read and talked about the various aspects of weather from the Sun, wind, and rain, to the work of the Weather Bureau. Then the sixth graders, while attending their week of school camp, have the opportunity of observing first hand, air pressure, winds, clouds, fronts, precipitation, and the movements of stormy areas across the country as shown by the weather map. From the actual experience of taking daily weather observations and preparing a simple forecast to the thrill of seeing their forecast become a reality, the campers are developing a basic appreciation of the world in which they live.

The observations and forecasts are done just before meal times, and the weather report read at the end of the meal in the dining hall. Each of the four groups has the opportunity of being the official forecasters for one entire day in addition to the several other times they do it on their own.

The work of making an observation and forecast is done in this manner. The counselor and his or her eight or ten campers

secure the necessary equipment from the weather station in one corner of the camp lodge. One camper takes the clip board of report forms. Another carries the cloud chart board, while another camper gets the nephoscope and compass. Outside by the instrument shelter the date and time are first recorded. The wet and dry bulb are read for the check on humidity. The highest and lowest temperatures for the last few hours are secured from the maximum-minimum thermometer inside the shelter. The wind direction is noted by observing the wind flag or streamer at the top of the weather flag pole. By using the Beaufort wind velocity chart posted on the side of the shelter, the campers determine the speed of the wind. They may observe smoke rising from a chimney, leaves in motion, dust or paper on the ground, or any of the several other things mentioned on the chart. If there are clouds directly overhead, they will place the nephoscope on the ground and orient it to the north by using the compass. Then by observing a wisp of cloud as it crosses the center of the mirror and noting the compass direction at the edge of the mirror where the cloud leaves, the direction of the winds aloft can be determined. The kind and amount of clouds are recorded by comparing the cloud chart pictures with those in the sky. After checking the rain gage, they are ready to complete the report inside the lodge. There the barometer is read and its tendency to rise, fall, or remain steady is noted. The humidity is determined by using a chart and the readings of the wet and dry bulbs. In order to explain better the effect of humidity on our bodily comfort, we have a large chart showing three areas of humidity: too much, too little, and just right. A sentence or two about each area helps the campers to see the importance of water vapor in the air. The last item is the forecast. By using the wind direction, the barometric tendency and barometer reading, with a prepared forecast chart they find what will probably result with the present weather conditions. The final part consists of running up the weather flag or flags for the current forecast.

This entire proceeding takes about ten minutes, and once the system is set up an enormous amount of learning and interest takes place in a short time. Certainly no camp can afford to be without a weather station.

We post the daily weather map in a line on the wall. In this manner the movement of fronts and stormy areas can be closely followed from day to day.

We have tried to keep our weather equipment simple, both from the standpoint of cost and to encourage teachers and other camp leaders to try amateur weather forecasting. We purchased a moderately-priced aneroid barometer, a rain gage, and a maximum-minimum thermometer. Other items in the homemade class consist of the instrument shelter, wet and dry bulb hygrometer, mirror nephoscope, and weather flags. Cloud charts and weather maps are from U. S. Weather Bureau, and other charts are printed by hand.

After using the camp weather station nearly all of the sixth graders return to their classrooms and set up weather stations. Together with weather experience at camp and the growing interest in weather because of television, we have a definite increase in the number of weather units studied in all of our elementary grades.

Weather Bureau Pamphlets

An educational series, consisting of 8 pamphlets, cloud charts, and maps, are distributed free to teachers by the U. S. Weather Bureau. Write on school stationary to: Librarian, U. S. Weather Bureau, Washington 25, D. C. For full list of government publications in meteorology, write to the Superintendent of Documents, GPO. Wash. 25, D. C.

Correspondence Courses

A complete curriculum in meteorology for home study is offered by two state universities. Full information may be secured by writing to:

Mineral Industries Extension Service,
Pennsylvania State Univ., State College, Pa.
Extension Service, Board of Higher Education,
Oregon State College, Corvallis, Oregon

Preparing for College Training in Meteorology

P. E. CHURCH, *University of Washington*
Chairman, Advisory Committee on Education, AMS

OPPORTUNITIES to study meteorology and climatology in American colleges have widened immensely in the past twenty years with the growing tendency, especially since World War II, for colleges to open regular meteorology departments on a par with chemistry or physics. Hand in hand with this increase of places where young men and women can obtain academic training on a professional level are more outlets for employment of well trained students.

To the student who in high school feels his interest in "weather" growing to the point that he would like to make "weather" his vocation in life, this committee would like to offer some specific advice to aid you in preparing for college training. This comes from the experience of many college professors who have had the problem of counseling newly entering students, many of whom had taken the wrong subjects in high school.

If you keep in mind several basic features about the atmosphere while you are in high school, you can better prepare yourself for the college work that lies ahead.

1. The atmosphere, a mixture of gases, obeys all gas laws with respect to such things as motion, heat and heat exchange, evaporation and condensation phenomena and others. The atmosphere is always in motion; it seems "restless."

2. There are many forces acting at the same time on the atmosphere. This complicates the study of the "why's," "where's," and "how's" of this envelope of air in which we live; the possibility of solving some of these "why's," "where's," and "how's" excites the alert student.

3. The atmosphere knows no international boundaries, so scientists in many foreign countries around the world are studying, doing research, and publishing newly discovered facts about the atmosphere. Though most foreign scientists can read and speak English, many of them publish in their native language.

4. The number of problems involving both meteorology and some other science or social science is rapidly increasing in business fields such as industry, commerce, agriculture, and transportation, as well as in the academic field.

5. Meteorology is a young science and just coming into its own. Its greatest advance has been since World War II.

With the foregoing in mind, to prepare yourself to go far in the profession, you will want to take all the mathematics you can in high school. This would include algebra, geometry, and trigonometry—prepare yourself so that when you enter college you can start college algebra and continue with advanced trigonometry, analytic geometry, some elementary statistics, and then a year of calculus. This amounts to a minimum of two years of mathematics in college; this is basic, by the way, to all physical sciences and to many biological sciences.

While you are taking mathematics in high school, you will also want to take as many other sciences as the high school curriculum offers, but by all means complete a year of physics and, almost as important, a year of chemistry. High school physics will better prepare you to master at least one year of general college physics which is an essential

requirement of students before starting the study of meteorology at the professional level.

Foreign languages in high school also help in later life. If your high school offers German, by all means make that your first choice. Take two years at least, because more scientific knowledge, especially meteorology, is published in German than in any other foreign language. If you cannot get German, then take two years of French. If these courses are not given, then I suggest more mathematics, science, geography, or English.

Good luck to you all.

The following educational institutions offer meteorological instruction, either at the elementary or advanced level or both:

University of California, Los Angeles 24
The University of Chicago, Chicago 37
Florida State University, Tallahassee
Iowa State College, Ames
Massachusetts Institute of Technology, Cambridge
The University of New Mexico, Albuquerque
New York University, New York, Bronx 53
The Ohio State University, Columbus
Oklahoma A & M College, Stillwater
Oregon State College, Corvallis
The Pennsylvania State University, State College
Rutgers University, New Brunswick
Saint Louis University, St. Louis
A & M College of Texas, College Station
The University of Texas, Austin
University of Utah, Salt Lake City 1
University of Washington, Seattle 5
University of Wisconsin, Madison

Many institutions, especially state universities and teachers colleges, offer elementary meteorology in various departments such as physics, geography, aviation, engineering, etc. Consult the complete catalog of the institution of your interest.

Weather Bureau Publications

DAILY WEATHER MAP (size 19 x 24 inches), issued and mailed from Washington, D. C., contains five charts showing the 1:30 a.m. surface weather data for the United States, the barometric and frontal pattern as it existed 12 hours earlier, precipitation totals for the past 24 hours, highest and lowest temperatures during the past 24 hours, and the 500-millibar constant pressure chart. Price, daily including Sundays and holidays, 60c per month, $7.20 per year.

AVERAGE MONTHLY WEATHER RESUME AND OUTLOOK presents in a graphic form the observed temperature and precipitation departures from normal for the past month and experimental monthly outlook covering expected temperature and precipitation conditions for the coming month. Printed semi-monthly, $2.40 for 6 months (minimum subscription), $4.80 per year.

WEEKLY WEATHER AND CROP BULLETIN gives a synopsis of weekly conditions and their effects on crops and farming. Also contains the snow and ice bulletin in winter. $3.00 per year. December through March only, $1.00.

CLIMATOLOGICAL DATA contains monthly climatological information for stations within a section. There are 45 sections, each usually corresponding to a state. Issued monthly with an annual summary. One section costs 15 cents per month, $1.50 per year. Forty-two sections, $4.00 per month, $48.00 per year.

STATION METEOROLOGICAL SUMMARY contains daily climatological data for each of about 250 first class weather bureau stations. Issued monthly. Fifty cents per year. Address the local weather bureau office concerned.

MONTHLY WEATHER REVIEW contains contributions from the research staff of the Weather Bureau and special contributions of a general character in any branch of meteorology or climatology. Issued monthly. $2.00 per year.

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Applications and remittances must be forwarded to the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for the above publications. Checks or money orders must be payable to the Treasurer of the United States.

Weather Activity in the Nation's Schools

Decatur, Illinois

Meteorology was offered the first year Lakeview High School opened its doors to the students in September 1949. It was offered on a trial basis as an elective semester science subject. Physiography is offered the second semester to complete a year's work in physical science. These courses are open to sophomore, junior, and senior students.

Student interest necessitated the purchase of meteorological equipment and the establishment of a functional weather station. The Lakeview Weather Station is now a firmly established part of the school and community.

Observations are taken at 0800, 1200 and 1600, seven days a week by student weather observers under the guidance of their instructor.

The information gathered at the Lakeview Weather Station is available to several industries in the community. The temperature records of the station have been used by the railroads of Decatur in settling claims on perishable items. The rains of March and April 1954, which eased the drought condition in the Decatur area, were of interest to all and the rain gauge of the Lakeview Weather Station was quite popular. The rainfall data was given to the radio stations for their weather broadcasts.

The instructor presents a 5-minute weather program six days each week and a special weather report to the farmers on a farm show on Saturdays on Decatur's television station WTVP (channel 17, UHF).

The students of the meteorology class maintain a daily weather map in the lobby of the school so that all students have an opportunity to "keep posted" on the weather. This map serves two purposes: it gives the students in meteorology a chance to put to use their classroom instruction and it has stimulated interest on the part of the students for meteorology.

The station has the following equipment: a set of max-min thermometers, an instrument shelter built from Weather Bureau plans by the industrial arts class, an aneroid barometer, a Weather Bureau rain gage, a wind vane and anemometer with an indoor indicator, and a sling psychrometer.

In addition to the above equipment, the class has access to the mercurial barometer and humidiguides of various types in the physics laboratory. The thermometers are registered to be accurate within one-tenth of one degree.

The text used is "The Earth and its Natural Resources" by Finch, Trewartha, Schearer, McGraw Hill 1948, with accompanying workbook, "Laboratory Exercises in Physical Geography." The new text "Earth Science" by Fletcher and Wolfe, Heath and Company 1953 and accompanying workbook are quite good and will probably be used the year 1954–1955.

LOREN F. BOATMAN
Instructor of Meteorology

North Andover, Massachusetts

Meteorology is taught at the Brooks School as one-third of the Fourth Form (grade 10) science course during January, February, and March. The weekly schedule includes one laboratory period of one hour and forty-five minutes and two recitations of one hour each. There are two classes of about twenty boys each.

Laboratory topics are weather instruments: their principles, installation, and use. Laboratory reports are written each week. Equipment consists of a complete weather station installed and in operation including: weather vane, anemometer with indoors dial, rain gauge, hygrometer, barometers (mercurial, aneroid, and barograph), maximum-minimum thermometer, and sling psychrometer. Additional sets of equipment are available for use in laboratory work.

Students record weather data twice a day on special forms. Recitation periods are devoted to a systematic discussion of many types of weather phenomena. We use as our text *Meteorology* by Wilson and Hannelly, supplemented with charts, slides, filmstrips, and models. We receive the U. S. Daily Weather map and devote two weeks to learning the symbols and techniques of making weather maps. Students frequently describe

the current weather situation and make forecasts, using blank maps and drawing fronts. Occasionally reports are made by students or teacher about articles in periodicals such as *Weatherwise, Science News Letter,* and *Earth Science Digest.*

OSCAR M. ROOT
Head of Science Department

Springfield, Massachusetts

We now offer meteorology at Springfield Technical High School as a half-year prepared subject, available to students of all courses as an elective. It includes such topics as: the basic physics and chemistry of the atmosphere; humidity, temperature, and pressure relationships; winds and air masses; traveling disturbances and fronts; clouds and types of precipitation; types of storms and their origin; weather map analysis and forecasting.

The laboratory work is concerned with the determination of the dew point, the measurement of relative humidity, the study of the factors controlling evaporation and the investigation of other related physics problems. Weather instruments which are checked daily by class members include the barometer, barograph, thermograph, psychrometer, weather vane, and anemometer.

The United States weather map is received daily and analyzed, and practice given in the construction of weather maps from station data. Opportunity is also provided the students for making their own weather forecasts based on data taken from the school's weather instruments. The monthly weather summary is regularly received from the University of Massachusetts and is carefully studied and discussed.

CHARLES R. ALLAN
Chairman, Science Dept.

Hawthorne, Massachusetts

Our program at the Essex County Agricultural School has two phases: (1) in school from Oct. 1–April 1, and (2) farm practice from April 1 –Oct. 1.

As an agricultural school we are particularly weather conscious; therefore, at the beginning of the Sophomore year we go more intensively into a "Frost Unit" which, of course, is particularly seasonal.

The students keep home temperature records and graph those temperatures. Since the students come from the entire county area, they become readily aware of "local" weather.

From these observations we go into the factors of frost formation—thence into weather and climate.

At the beginning of the Senior year this work is expanded in breadth to general weather forecasting and in depth to a more complete understanding of the physical principles and laws involved. In the latter case it serves the additional purpose of an introduction to heating, ventilation and the principles involved.

LOUIS F. MICHELSON
Instructor

Flagler, Colorado

Our work in meteorology is in its infancy. We have set up a weather recording station consisting of an electric anemometer and wind vane, aneroid barometer, maximum-minimum thermometer, rain and snow gage, and a sling psychometer.

Daily readings are taken, including general weather conditions and cloud formations. Weather maps are taken from the daily papers and forecasts are made from these and from reports of the weather recording stations in our immediate vicinity.

We try to acquaint the student with the significance of changing weather conditions and the terminology of the science of meteorology.

We plan the formation of a science club this next school year and will continue the advancement of our weather project in conjunction with this club.

EUGENE T. KNIGHT
Science Director

Auburn, Washington

In addition to our unit of study on weather, which takes about three weeks of our regular ninth grade general science course, we have a continuing project of observing and recording of weather data.

We built a platform on the roof of the school which contains a rain gauge, minimum and maximum thermometer, and anemometer. For humidity reading we use a sling psychrometer.

Two interested boys are selected from the first period science class to take the readings in the morning along with observation of the amount and type of clouds. This information is sent to the office and is included in the daily bulletin. A weather forecast is also put in the bulletin which is based mainly on the information of the U. S. Weather Bureau early morning direct report over the radio.

We also have subscribed to the Weather Bureau's bulletin "Local Climatological Data" which gives us a summary of the previous months weather. We also received the Weather Bureau daily weather map.

A. J. KING
Auburn Junior High School

Fort Wayne, Indiana

At present we have fifteen students at Central Catholic High School who observe, record, and forecast the weather in a manner which I shall describe. Readings are taken from instruments which are kept in the instrument shelter on the roof of our school, four stories high. I am inclosing a picture which was taken early this year. The instruments on the roof are an anemometer and wind direction finder, minimum-maximum thermometer, hygrometer, barometer, sling psychrometer, and rain gauge. These readings are then interpreted for our station report in code. We obtain relative humidity and dew point from Psychrometric Tables obtained from the U. S. Department of Commerce Weather Bureau. We forecast by means of the Kenyon Weathercaster, based on barometric readings, and another Cloud Weathercaster, based on the clouds in the sky.

Three students observe and forecast each day and record the observed data on a sheet which is placed on the blackboard beside our daily coded report. Each morning a student gives the forecast over our public address system. The accuracy is good—and our students enjoy it. When the weather does not turn out as predicted, we are teased in the same way as our *real* weathermen.

We are also planning to transfer information from teletype sheets, obtained from Baer Field, to daily weather maps—just for our own experience. Our work in meteorology is extra-curricular.

SISTER MIRIAM JOSEPH
Science Teacher

Philadelphia, Pennsylvania

Several years ago members at the Franklin Institute sought to arouse enthusiasm among student delegates from the Student Councils in establishing Weather Observation Posts in the high schools. The plan was to record weather variations in all parts of the city from instrument readings made by high school clubs and send them to the Franklin Institute.

We established an Amateur Weatherman's Club at Dobbins Vocational High School. Financial assistance was obtained from school funds which were eventually repaid by club dues. About $150 was spent for instruments and materials but the cost can be less if ingenuity is used. Among our purchases were: Stewart-type electric wind vane and anemometer, U. S. Weather Bureau type thermometers, including minimum, maximum, wet and dry bulb. We took the "sling" off the psychrometer, fixed it in place and used an old heater blower.

We are fortunate in being able to use the microbarograph belonging to the physics department. The Carpenter Shop built a thermometer shelter from plans obtained from the U. S. Weather Bureau. The stand for the shelter was made by the Welding Shop. An eighteen foot tall telescopic mast for the anemometer and wind vane was made by the Plumbing Shop. The outdoor equipment was installed on the ninth floor roof at the highest point on the building. Wiring arrangements by the Electrical Shop allow us to read wind speed and direction conveniently and accurately indoors.

The daily work of recording instrument readings, making forecasts, and posting the results in a conspicuous spot in the students' lunchroom is apportioned among groups of the club members who use a part of their own lunchtime to do it. A weekly session after school is used in teaching the use of

(Continued on page 136)

A Selected Bibliography in Meteorology

POPULAR: Brooks, C. F., *Why the Weather.* 2nd ed. Harcourt, Brace and Company, 1935. A description of American weather by seasons. Contains many accounts of interesting weather phenomena of the past. Good for high school students.

Fisher, R. M., *How to Know and Predict the Weather.* (Original title: *How About the Weather?* Harpers, 1951.) A Mentor Book, M84. The New American Library of World Literature, Inc., New York, 1953. 167 p. 35¢. Covers the elementary physics of the atmosphere plus material on forecasting from newspaper maps and local signs. Sixteen illustration plates.

Hare, F. K., *The Restless Atmosphere.* Hutchinson's University Library. Longmans, Green and Co., Inc., New York, 1953. 192 p. $2.40. (Textbook edition—$1.80.) Contains a brief review of the physical laws governing weather processes, then treats the principal regions of the earth in terms of dynamic climatology.

Haynes, B. A., *Techniques of Observing the Weather.* John Wiley & Sons, New York, 1947. 272 p. $4.50. Descriptions and illustrations of principal Weather Bureau instruments, with instructions for making and recording observations.

Inwards, R., *Weather Lore,* 4th ed. Edited by E. L. Hawke, Rider and Co., London, 1950. 251 p. $2.10. The classical collection of sayings and proverbs on weather lore. Republished for the Royal Meteorological Society.

Longstreth, T. M., *Understanding the Weather.* (A revision of *Knowing the Weather,* 1943.) The MacMillan Company, New York, 1953. 118 p. 13 cloud photos. $2.50. A very lively and readable account of the behavior of the weather elements. Recommended as a first book on the weather.

Schneider, H., *Everyday Weather and How It Works.* McGraw-Hill Book Co., New York, 1951. $2.75. An explanation of the daily weather processes with instruction for making simple weather instruments. Recommended for junior and senior high schools.

Sloane, Eric, *Eric Sloane's Weather Book.* Little, Brown and Company, Boston, 1952. 90 pages. 80 illustrations. $3.95. A coordinated collection of Eric Sloane's well-known weather illustrations and cartoons with appropriate text. Will be appreciated by all ages.

Spilhaus, A. F., *Weathercraft.* The Viking Press, New York, 1951. 64 p. $2.00. Shows how to assemble and operate a home weather station made from easily-obtained materials.

Tannehill, I. R., *Weather Around the World.* 2nd ed. Princeton University Press, Princeton, 1951. 212 p. $3.50. A description of normal weather at sea and in port for the world traveller.

Wilson, V. and Berke, J., *Watch Out For The Weather.* The Viking Press, New York, 1951. 256 p. $2.95. An account of how the weather and climate affect your health and daily life.

Yates, R. F., *Weather for a Hobby.* Dodd, Mead and Co., New York, 1946. 172 p. $2.75. Deals mainly with all types of amateur instrument making, with full plans for a home observatory.

ELEMENTARY TEXTS: Blair, T. A., *Weather Elements*. 3rd ed. Prentice-Hall New York, 1948. 373 p. $5.65. School edition $4.25. A basic text of long standing. Suitable for advanced high school students.

Boy Scouts of America, *Weather*. Boy Scouts of America, New York, 1952. Merit badge instruction booklet. Up-to-date and very practical.

Kraught, P. E., *Meteorology for Ship and Aircraft Operation*. Cornell Maritime Press, Cambridge, Md., 1944. 384 p. $3.50. A good text for all-around purposes. Many easy-to-understand illustrations.

Neuberger, H., and Stephens, F. B., *Weather and Man*. Prentice-Hall, New York, 1948. 281 p. $5.00. An introductory text is followed by a description of how weather affects man in his private and business life. Especially good for college survey courses or home study.

Petterssen, S., *Introduction to Meteorology*. McGraw-Hill Book Co., New York, 1942. 236 p. $4.50. An admirably concise presentation of the basic physical principles on which modern forecasting is based.

Spitz, A. N., *A Start in Meteorology*. Roger B. Henley, New York, 1943. 97 p. $1.50. A concise introductory text with emphasis on the basic physics of the atmosphere. Illustrated by the author.

Tannehill, I. R., *All About the Weather*. Random House, New York, 1953. 148 p. $1.95. Explains how to observe the weather, how forecasts are made, how to read weather maps. An introduction suitable for 9 to 12 age group.

Taylor, G. F., *Elementary Meteorology*. Prentice-Hall, New York, 1954. 364 p. $7.95. An up-to-date textbook.

Wilson, J. R., and Hannelly, R. J., *Meteorology, An Elementary Textbook*. Printery Publishing Co., Phoenix, 1951. 92 p. $3.20. School price: $2.40. A well-illustrated textbook for a practical high school meteorology course.

ADVANCED TEXTS: Byers, H. R., *General Meteorology*. McGraw-Hill Book Co., New York, 1944. 645 p. $7.00. A well-balanced college text with due emphasis on aeronautical aspects.

Neuberger, H., *Introduction to Physical Meteorology*. The Pennsylvania State University, State College, Pa. 271 p. $3.50. Provides a basic understanding of the physical principles where most texts are weak.

Willett, H. C. *Descriptive Meteorology*. Academic Press, New York, 1944. 310 p. $6.00. Treats the theories of the general circulation of the atmosphere. Strong on air masses and North American weather types. Useful to the non-mathematically inclined as well as to the technical student.

HANDBOOKS: Berry, Bollay, and Beers. *Handbook of Meteorology*. McGraw-Hill Book Co., New York, 1945. 1,116 p. 730 illus. $13.50. A survey of the entire field of meteorology.

Malone, T., ed., *Compendium of Meteorology*. American Meteorological Society, Boston, 1951. 1,334 p. $12.00. Contains 108 articles which survey the present status of the science and make suggestions for future directions of progress. Indispensable as a reference work for the student of meteorology.

WORKBOOKS: Caudle, F. L., *Workbook in Elementary Meteorology*. McGraw-Hill Book Co., 1945. 191 p. $2.20. Problems, quizzes, and map drawing exercises.

Kraght, P., *Meteorology Workbook with Problems*. Cornell Maritime Press, Cambridge, Md., 1943. $2.50. Problems, quizzes, and map drawing exercises.

Pulk, E. S., and Murphy, E. A., *Workbook for Weather Forecasting*. Prentice-Hall, Inc., New York, 1950. 66 p. with kit of 30 practice charts. $5.00. Contains instructions for plotting and analyzing synoptic weather maps along with a discussion of forecasting methods.

CLIMATOLOGY: Brooks, C. E. P., *Climate in Everyday Life*. Philosophical Library, New York, 1951. 314 p. $4.75. A discussion of the climate factors and how they affect our daily life and business.

Haurwitz, B., and Austin, J. M., *Climatology*. McGraw-Hill Book Co., New York, 1944. 410 p. $8.00. A survey of the elements that make up our climate and a regional account of the world's climate zones. The approach is from the dynamic climatology viewpoint with much on air masses and disturbances.

Kendrew, W. G., *Climatology*. 3rd ed. Oxford, Clarendon Press, London, 1949. 383 p. $7.50. A revision of the standard work in the field.

Trewartha, G. T., *An Introduction to Climate*. McGraw-Hill Book Co., New York, 1953. 3rd ed. 416 p. $7.00. Emphasizes both the systematic aspects of climatology and the regional features as revealed in the world weather pattern. Suitable for advanced students.

SPECIAL SUBJECTS: Flora, S. D., *Tornadoes*. Oklahoma University Press, Norman, 1953. 208 p. $3.50. A descriptive summary of all we know about tornadoes. Lists by states of all principal tornado occurrences.

Tannehill, I. R., *Drought. Its Causes and Effects*. Princeton University Press, Princeton, 1947. 246 p. $3.00.

Tannehill, I. R., *Hurricanes*. 7th ed. Princeton University Press, Princeton, 1950. 304 p. $3.00.

U. S. Weather Bureau, *The Thunderstorm*. Government Printing Office, Washington, 1950. 287 p. $2.25. A summary of the findings of the Thunderstorm Project.

PERIODICALS: *Monthly Weather Review*. Monthly. Now in v. 82, n. 10, October 1954. Annual subscription $3.50. Published by the U. S. Weather Bureau. Subscription Office: Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Weather. Monthly. Now in v. 9, n. 10, October 1954. Annual subscription 24 shillings ($3.50): Weather, 49 Cromwell Road, London, S.W. 7, England.

Weatherwise. Bi-monthly. Now in v. 7, n. 5, October 1954. Annual subscription $3.00: American Meteorological Society, 3 Joy Street, Boston 8, Mass.

World Meteorological Organization Bulletin. Quarterly. Now in v. 3, n. 4, October 1954. Annual subscription $1.00: World Meteorological Organization, Campagne-Rigot 1, Avenue de la Paix, Geneva, Switzerland.

Educational Films in Meteorology

For Senior High Schools

Aerology Series: 8 Films. 1943–44.
U. S. Navy. Free loan.

ICE FORMATION ON AIRCRAFT (Part 1), HOW AND WHERE ICE FORMS (Part 2) (MN-119A 48 minutes). Shows processes of ice formation, effects of ice on aircraft, and explains how wings ice, and how ice in the pitot tube, on the propeller, and in the carburetor becomes a flying hazard.

FOG (MN-119B 25 min. color). The theory of fog formation is discussed briefly. The characteristics and conditions conducive to fog are considered in detail.

THUNDERSTORMS (MN-119C 41 min.). Deals with the formation of thunderclouds; points out their identifying features; discusses alternatives a pilot may follow when storms are encountered, and dramatizes one pilot's experience with a thunderstorm. Animation and some straight photography are used.

AIR MASSES AND FRONTS (MN-119D 26 min. color). Describes the troposphere, the formation of clouds, warm and cold fronts, and cyclones, and explains the conditions responsible for different kinds of weather.

THE COLD FRONT (MN-119E 19 min. color). Explains the formation, characteristics, and dangers of a cold front; demonstrates how to avoid the hazards of the cold front by either high or low level flight.

THE WARM FRONT (MN-119F 21 min. color). Explains the meeting boundaries of warm and cold air, dangerous stratified layers of clouds formed, how to plan a course around them, types of visibility, precipitation, and ceiling conditions, their locations, cirrus, cirrostratus, and alto-stratus clouds.

THE OCCLUDED FRONTS (MN-119G 22 min. color). Shows the development and movement of cyclones and the initial stages of the warm and cold fronts. Demonstrates on a weather map the action of cold and warm front type occlusions. Points out the weather problems in flight operation in warm and cold front type occlusions.

FLYING THE WEATHER MAP (MN-119H 27 min. color). Shows observers determining weather conditions. Illustrates the map's features and shows various fronts represented by colored lines. Explains symbols indicating precipitation areas, thunderstorms, rain showers, air masses, and pressure areas.

The Aerology Series were originally produced for the U. S. Navy and until recently were distributed by the Civil Aeronautics Administration. They may now be obtained for free loan from:

University of Illinois, Visual Aids Service, Champaign, Ill.
Texas Christian University, Visual Aids Dept., Dallas, Texas.
Air Force Reserve Unit, 5651 West Manchester Avenue, Los Angeles 45, Calif.
University of Washington, Visual Aids Dept., Seattle, Wash.
Hofstra College, Audio-Visual Aids Dept., Hempstead, New York.

CLOUDS. AlmanacFlms 1951 10 min. (John Kieran's kaleidoscope series.) $45.

"Clouds are forever changing and we look to them as a guide for weather—sharp and bright for clear days, dark and forbidding for stormy days. Why we have clouds, what they do for us and how they are formed by shifting air currents, is a fascinating subject which we investigate thru time-lapse photography."

CLOUDS. UW-Govt. 1927 (rev. 1939) 11 min. $17.96.

Produced by the U. S. Weather Bureau.

The various types of clouds are shown, and the movement of high and low pressure areas across the country is described. Weather forecasting as the result of cloud study is discussed.

HURRICANE CIRCUIT. UW-Govt. 1949 23 min. $41.92.

Produced for U. S. Department of State overseas programs.

Shows how the warning center at Miami, Florida, reduces hurricane menace in the Caribbean and the Gulf of Mexico, the operation of the warning system, precautions against damage, rescue and relief measures, and international aspects of the warning system. The nature of hurricanes is shown by animation.

HURRICANE HUNTERS. USAirForce 1953 15 min. free-loan.

The story of the flying weathermen who fly into the center of a hurricane to measure its force and plot its direction.

WEATHER MEN OF THE SEA. USCCoastGd 1950 14 min. free-loan.

Stresses the importance of duties and service to man performed by the ocean weather station vessels operated by the Coast Guard. The activities of one vessel at a point in rough North Atlantic waters are followed on its tour of duty.

TORNADO WARNINGS. UW-Govt. 1953 11 min. $17.96.

Produced by the U. S. Weather Bureau.

Explains the atmospheric conditions causing tornadoes and the work of the U. S. Air Force, U. S. Weather Bureau, and volunteer weather observers in predicting the paths of tornadoes. Contains scenes of various tornadoes.

For Junior and Senior High Schools

MODERN WEATHER: THEORY AND STRUCTURE OF STORMS (2 parts). UW-Govt. 1940.

Produced by the U. S. Army Air Forces.

I. Development and Characteristics of Atmospheric Waves (15 min. $24.82). Animation

maps, and narration, explaining the principles of the development and characteristics of atmospheric waves.

II. Primary Circulation (19 min. $29.99). Animation and maps show weather under normal conditions and the atmosphere that creates the prevailing winds. The principle of the air currents created by the tropical regions and the polar regions is described. Maps and diagrams also show the zones of the prevailing westerlies, trade winds and the way in which warm, moist air rises, cools by expansion, and loses its moisture by precipitation.

WEATHER. Gateway 1951 10 min. (Gateway primary science ser.) $49.50, rent $4.50. 551.5.

Produced by John F. Criswell.

Changes in the weather are explained, together with reasons for wind, heat, clouds, and rain. Illustrates how weather is forecast and why it is important to us.

For Elementary, Junior and Senior High Schools

THE CLOUDS ABOVE. Bailey 1948 (rev. 1951) 10 min. $45, rent $2.50; color $100; rent $4.50.

Shows the four main types of clouds and explains their significance. The absorption of water by air and the process of condensation are illustrated. How these processes are involved in the formation of clouds and precipitation of rainfall is then demonstrated in a simple animated sequence.

GREAT WINDS (general circulation). UW-Educ. 1951 10 min. $50, color $100. 551.5.

Produced by Gaumont-British Instructional Films. Re-edited and American narration added by United World Films.

Locates principal pressure areas as affected by the position of the overhead noonday sun: at the Equator; at the Poles; at the subtropical regions; at belts between the Poles and subtropics. The flow of air from high to low pressure areas is shown to establish the general circulation. The globe is rotated to illustrate deflection of winds and to indicate the paths of trade winds and westerlies.

HOW WEATHER IS FORECAST. Coronet 1953 10 min. $55, color $110.

Shows the operation of a weather observation station and a weather forecasting station. By means of animation, a weather map is charted and its symbols explained. The instruments used in weather forecasting and their functions are discussed.

SNOW HARVEST. UW-Govt. 1946 33 min. color $139.37.

Produced by the U. S. Dept. of Agriculture.

Shows the importance and hazardous activity of making snow surveys in the West; the techniques of measuring snow to forecast irrigation and other water supplies. The film includes beautiful winter scenery.

STORY OF A STORM. Coronet 1950 10 min. $50, color $100.

Educational consultant: Walter A. Thurber.

Shows what conditions cause a rain storm to develop; names the different kinds of clouds; and presents a general knowledge of pressure areas, fronts, meteorological instruments.

WHAT MAKES RAIN? Young America 1947 10 min. (Elementary science ser.) $45. 551.5.

Educational consultant: Gerald S. Craig.

"An excellent presentation for intermediate grade science classes of the rather complicated water cycle. The narrator has a pleasant style, and the explanation is built slowly and well reinforced. The terms used are shown on the screen at the appropriate moment, and each is well illustrated. The explanation of the water cycle is greatly simplified, but the actual formation of drops of water and other details need not enter into an explanation on this level."

WINDS AND THEIR CAUSES. Coronet 1948 10 min. $50, color $100.

Educational consultant: Walter A. Thurber.

Shows the causes of heat currents and thunderstorms by means of animation. A sail boat illustrates the effects of off-shore and on-shore winds, and a globe is used to depict the causes of easterly and westerly winds.

The standard reference is *Educational Film Guide,* 11th Edition, edited by Frederic A. Krahn, The H. W. Wilson Company, 950 University Avenue, New York 52, N. Y. 1953. Semi-annual supplements are issued.

All Weather Bureau films and many of the above list may be borrowed or rented from your state film depository, usually located in the Audio Visual Aids Dept. of your state university.

WEATHER STUDY KITS

Two new teaching aids for weather study are now available. A Model Weather Station Kit, designed for elementary and junior high school students, is produced by Model of Industry, Inc. of California and sells for $5.95. A more elaborate kit for high school age students is distributed by Industrial America of Chicago and sells for $24.95. Write *Weatherwise* for full information.

AMATEUR WEATHERMAN'S ALMANAC

The Amateur Weatherman's Almanac is an annual publication of *Weatherwise* containing a summary of the interesting weather phenomena and events of the past year. It was first published in 1952 and is now in its third year. Back issues available. Send $1.00 in cash or check for each issue to Weatherwise, Franklin Institute, Philadelphia 3, Penna.

Opportunities (*Continued from page 119*)

Bureau are known as Meteorological Aides. Often nonprofessional personnel will acquire familiarity with meteorological theory, map analysis and forecasting, and assist professionals. Most organizations employing a number of professional personnel will need a larger number of nonprofessionals, too, who are responsible for preparing the basic weather data as a source of present and future projects.

Where the Meteorologist Works

An analysis of occupations was made in a study of 2,180 professional members of the American Meteorological Society in May 1954. This figure does not represent all professionals actively employed in this country. For reasons unknown to the Society, there exists a lack of professional pride among some professionals which results in a failure to complete the application form and become members. (This is unfortunate since the Society serves the professional, nonprofessional, student, and amateur through its services and publications in keeping abreast of current scientific, technical, and employment developments.) The figure of 2,180 serves as a good yardstick of job placement, however. The figures below are especially revealing when one considers that 25 years ago meteorology was a government monopoly with practically all activity centered in the U. S. Weather Bureau.

Affiliations of 2,180 Professional Members of the AMS:

Military Services	633
U. S. Weather Bureau	586
Educational and scientific organizations	359
Industry	342
Other government service	185
Unknown (cannot be determined)	51
Retired	18
Miscellaneous	6

Under military services it should be remembered that there are a large number of civilian employees as well as those in uniform. For example, the Air Force Cambridge Research Center with headquarters in Boston employs a large number of civilian personnel in carrying on its many meteorological research projects, many of whom are employed through contracts with universities and other research organizations. The Office of Naval Research in Washington, D. C., operating along similar lines, should be mentioned as well as the U. S. Navy Hydrographic Office, the U. S. Army Signal Corps, the Army's Quartermaster and Engineer Corps, the Army Chemical Warfare centers, and the National Bureau of Standards. Activities of the professional and nonprofessional alike are utilized, and the civilian employment carries regular Civil Service ratings.

The responsibility of our national weather service, the U. S. Weather Bureau, is to collect basic weather and climatic data and to issue daily forecasts and severe weather warnings for the welfare of the general public. The Weather Bureau, like the military services, offers a wide geographical distribution in job location. The Weather Bureau recognizes that positions for professional meteorologists offer the broadest career opportunities, but an equal number of nonprofessionals is employed by the Bureau in a wide variety of capacities. Professional positions carry the title of General Service Meteorologists; the majority of these are engaged in aviation weather duties along with furnishing a general weather service for local areas. As more experience is accumulated by the Bureau employee, advancement is made to positions of a more specialized nature or to administrative jobs. Supervisory positions require leadership ability in addition to technical competence. A considerable amount of research is carried on by the Weather Bureau within its organization. Theory and practice has made famous the 30-day forecasts of the Extended Forecast Division as one example.

Education and scientific organizations employing weathermen include colleges and universities, foundations, and research institutions. Meteorologists, in addition to teaching and carrying on research in a department of meteorology, are employed in colleges within other departments where they teach geophysics, physical or natural science, or engineering in combination with courses in meteorology. Or the meteorologist may be working on research in association with another department engaged in problems of agriculture, biology, forestry, irrigation, and insect control. Meteorologists in foundations

(*Continued on page 136*)

Weatherwatch

Summer 1954—Heat and Hurricanes

DAVID M. LUDLUM, *Editor*

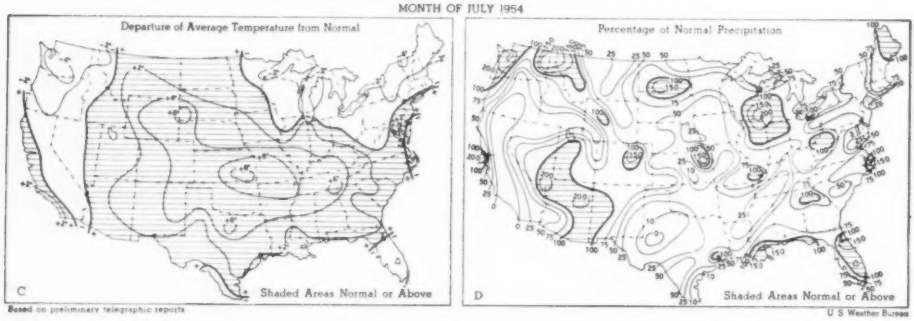
THE summer of 1954 will long be remembered in the interior of central and southern United States for its long-continued heat wave. There have been a series of very hot periods during the summers of the past five years, but 1954 topped them all and will take a place with 1901, 1934, and 1936 as years of major heat. The hot weather set in during early June with plus 100° readings being an almost daily occurrence somewhere in the area bounded on the west by the eastern Rockies and on the north by the Denver-Kansas City-Washington line. The real searing, however, commenced early in July, reached a climax from the 10th to 14th, and continued almost unbroken through the month and with only brief respites through August.

New absolute maxima for July and for all-time were set in places as remote as Casper, Wyoming, and Wilmington, Delaware, and Austin, Texas, and Youngstown, Ohio. Missouri, plagued by a devastating drought the previous summer, was apparently the worst sufferer as the combined heat and drought made it a major disaster area again. On the 14th St. Louis reached an all-time maximum of 115°; at Columbia and Springfield the peak was 113°. Heat marks which had been set in the torrid summers of 1934 and 1936 toppled in many states. At many points it was the hottest calendar month on record.

A typical sufferer in the interior Southland was Ft. Smith, in northwestern Arkansas, where 100° or more readings were recorded on 7 days in June, on 21 in July, and on 20 in August. The principal periods of consecutive 100° days were 23–29 June, 7–18 July, and 10–19 August. The 111° registered on the 14th exceeded the all-time July maximum, and was within two degrees of the absolute high set in August 1936.

It was not a torrid summer everywhere in the country, however, or even in all parts of the great interior basin. Temperatures were near normal in the upper Mississippi Valley and below normal from the Great Lakes east to the Atlantic Coast. And in the Pacific Northwest readings were decidedly below normal. Don Cameron has pointed out to *Weatherwatch* the great contrast in summer 1954 averages between Wichita, Kansas, and Yakima, Washington. From June through August readings averaged 5.6° above normal at Wichita, while at Yakima they were 5.1° below normal. The summer averages at the two points differed by 20 degrees. Such contrasts between different thermal sections of the United States are not unusual in such a large land mass as the United States, but in 1954 they were particularly outstanding.

THE CIRCULATION—A study of the upper air situation readily explains the reasons for the persistence of the heat. As H. F. Hawkins, Jr., will point out in the *Monthly Weather Review*, the circulation was typical of a North American summer; troughs were located off both the east and the west coasts and a large, domineering, warm anticyclone spread across the southern and central sections of the United States. This high, which in June was centered on the Gulf Coast of Alabama, showed a tendency to move northwestward during July to an interior position over the Oklahoma-Arkansas sector. The slow drift of this great high brought either an intensification or a slight relaxation of the heat regime as it slowly spread its influence from area to area. During the record-breaking days of mid-July it was centered over the Ozarks area and hence the peak readings just to



Departure of Mean Temperature from Normal in degrees Fahrenheit. USWB chart.

Percentage of Normal Precipitation. USWB chart.

the north of the center in Missouri during those days. Later in the summer it drifted eastward again to a position over northern Mississippi and Alabama to bring a long heat spell to the area south and southeast of the Ohio Valley.

Across the northern part of the United States the westerly jet stream aloft was somewhat stronger than normal and close to its usual position. Most active lows crossed the continent through central Canada with only their trailing fronts dipping south of the border. As the fronts circled the periphery of the great anticyclone in the South, they dropped down into New England, bringing polar air masses with them to give New England its coolest summer in a decade. Loud were the complaints from vacationers and farmers at the cool and usually cloudy weather of summer 1954 there. But further south in the Middle Atlantic States south of New York City, though temperatures were generally comfortable with very few successive sticky days, a severe drought brought ruin to home gardens and lawns and cut down many early truck crops.

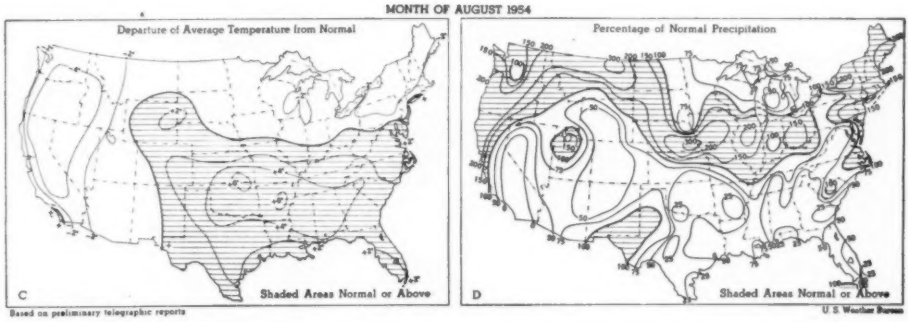
West of the Rockies it was generally a cool and fairly moist summer. Successive intrusions of cool Pacific air penetrated the Northwest coast and most inland areas to the Rockies. Many plateau sections averaged 4 degrees below normal for July and August, and rainfall was generous especially along the coast of Oregon and Washington. In August heavier than normal precipitation extended over and east of the Rockies in the North and thence in a band southeastward to the Ohio Valley. Jay Winston of the Extended Forecast Section, in a communication to *Weatherwatch*, has attributed this to the stronger than normal westerlies which had a long fetch across the cool Pacific Ocean. In August the polar front was further south than is normal for the month, and thus the cool air supplied the mechanism to set off numerous showers over the northern parts of the U. S., in contrast to the almost absolute drought and severe heat to the south from Arizona to the Atlantic.

HURRICANE CAROL—By far the most spectacular meteorological event of the summer came on the last day of the period under survey. On 31 August the third tropical storm of the season smashed across Long Island and into eastern New England as a full-fledged hurricane, causing over 70 deaths and damage estimated at near $500 million. There was a tendency among forecasters and newscasters to underestimate and to play down the threat of this storm, in much the same way that the Great New England Hurricane of 1938 was treated.

Carol had a rather undistinguished early history. A suspicious circulation was noted to the northeast of the Bahamas on 25 August, but during the next four days it moved but little toward the northwest, though retaining a distinct circulation with hurricane force winds over a small area. By noon of the 30th Carol commenced a steady movement northward off the Carolina coast and passed to the east of Cape Hatteras about 2000 on the 30th. From there it accelerated its pace, as had the 1938 blow, and crossed the Long Island shore near Westhampton at about 10:00 on the 31st.

When most residents of New York and New England went to bed on the 30th, there were no hurricane warnings in the news broadcasts. It was not until the 0600 advisory on the 31st that the path was forecast to cross Long Island and then gale warnings and not hurricane warnings were issued. It is apparent that no one knew exactly what was lurking in the dangerous eastern sector of Carol. By the time warnings were issued, power lines were down and residents of coastal New England had full hurricane winds to contend with. The havoc to beach homes and small craft was enormous along the beaches and harbors, flood damage was severe in all estuaries that faced south, and damage in the interior to trees and power lines exceeded the 1938 totals.

The path of Carol across Long Island was very close to that of the hurricane of 1938, but over New England it was to the east of 1938 and to the west of that of 1944. The eye of Carol entered New England near Westerly, R. I., passed between Boston and Worcester, and then sped at an accelerating pace up the Maine-New Hampshire border to the vicinity of Quebec. At Providence, R. I., just to the east of the center, the peak gust was 105 mph. at 1030 EST. At Boston, where the lowest pressure read 28.37 inches, the highest gust was 100 mph. at 1126 EST and the highest minute of sustained winds was 86 mph. from the southeast. Farther north the peak gust of 78 mph. at Portland, Maine, came at 1321. West of the axis of movement, hurricane strength winds were not reported, and thus a large area, devastated in 1938, was spared severe damage in this year's visitation from the tropics.



Departure of Mean Temperature from Normal in degrees Fahrenheit. USWB chart.

Percentage of Normal Precipitation. USWB chart.

Opportunities (*Continued from page 133*)

and research institutions, in addition to wholly research activities, may be editors, administrators, or science writers. Popular writing and public lecturing as weather careers have not been fully developed at present.

The industrial meteorology category offers weather engineers the greatest opportunity for expansion and also the greatest remuneration. There is no phase of human activity which is not affected by the weather, and the intelligent use of the weather factor in business, industrial, and agricultural operations, even on the present small scale, has been profitable. A chemical industry seeks the advice of weathermen on plant location and problems of air pollution and smoke control; another has established its own radar network for spotting hurricanes to anticipate plant shut-down and evacuation of exposed locations. In shipping and transportation services, many airlines long ago set up their own departments of meteorology. Public utilities need weather information to anticipate consumer loads and distribution, and a few employ staff meteorologists. An insurance firm in the Middle West employs two meteorologists for research on problems of hail damage to agriculture. Oil companies in the offshore drilling operations in the Gulf of Mexico have sought meteorological assistance for practically every phase of their operations. Lawyers often need weather reports and their intelligent interpretation by experts in presenting evidence in damage suits. A leading department store in the Middle West stated this past July: "We know that the weather is an essential factor in almost every customer contact." Business and industrial leaders who do not hire staff meteorologists make use of private weather consulting services, either occasionally or on a regular monthly or yearly basis for set fees.

In the Professional Directory of the *Bulletin of the American Meteorological Society* there are 17 card advertisements of private consultants and weather services. They serve the specialized weather needs of clients who include city officials desiring an alert for snow removal, baseball park managers, candy manufacturers, and cattle ranchers and agriculturists who are willing to undertake rainmaking experiments for their drought-stricken land. In the case of the department store, the weathermen and businessmen need to get together for a statistical analysis of the store's operations; then the meteorologist can be helpful in timing special sales, seasonal goods, advertising, and the number of sales personnel needed. Radio-TV stations are now employing more and more professional meteorologists to present and interpret weather conditions at first hand in preference to the glamorous telegenic types who merely read stereotyped data.

In our last few categories of occupations of 2,180 professional AMS members 'other government service' refers to organizations such as the U. S. Bureau of Reclamation, U. S. Geological Survey, Soil Conservation Service, all of whom employ meteorologists. Foreign government weather services often hire trained American personnel, and the World Meteorological Organization, a part of the United Nations, offers employment in the Technical Assistance Programs.

In the survey of 2,180 weather professionals, only two per cent were women, pointing to weighty competition. Women should not be discouraged, however, for with proper education and spirit, they will continue to reduce the barriers. There must always be pioneers!

And so we see that interest in weather ranges from the schoolboy with splashing garden hose to the corporation chairman in his air-conditioned office. Both should be keenly interested in the meteorological talk of rainmaking, dispersion of hail, machine forecasting, capturing the jet stream, solar energy, survival in the arctic. We are all aware of the needs for better planning to lead to easier and more efficient, and therefore more intelligent, living standards.

Weather Activity (*Cont. from page 127*)

instruments and elementary meteorological theory, and for transacting club business.

Although the original idea of contributing to a city-wide compilation of temperatures and humidities did not develop, we have felt here that the club is quite worth while for ourselves.

CHESTER E. LAMPE
Physics Department

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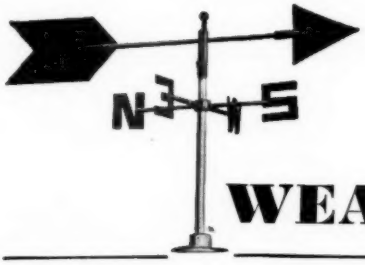

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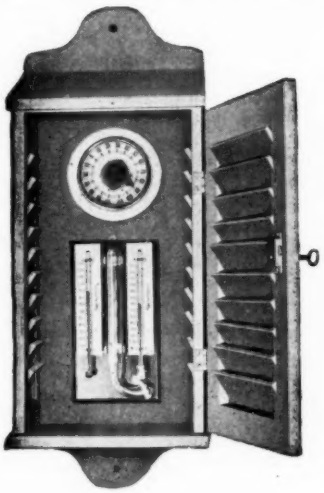

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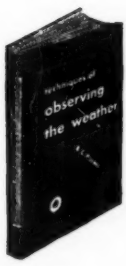
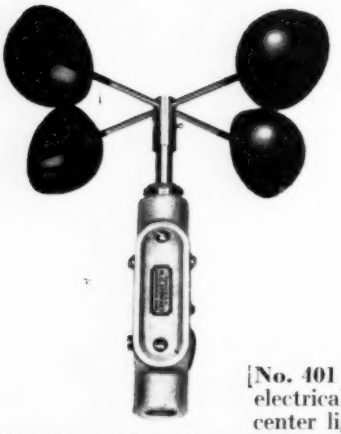
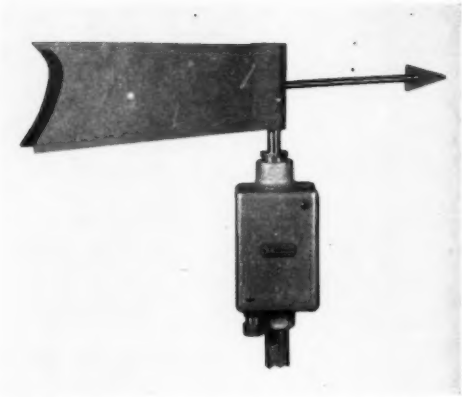


Weather

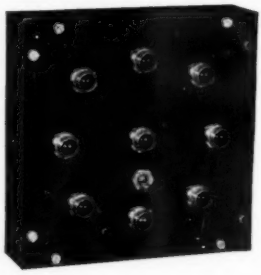
Low Cost Wind Set





No. 425 Electric Wind Vane. Plastic wind vane has electrical contact mechanism to transmit wind direction data to a remote point when used with No. 475 Indicator. Lighted lamps show direction to 16 points of compass. Non-corrosive construction. Requires 6 volts. **$22.50**

No. 401 Electric Anemometer. Four-cup anemometer makes electrical contact for each 1/60th mile of wind passing. Flashes center light on No. 475 Indicator. Number of flashes per minute is speed of wind in miles per hour. Requires 6 volts. **$22.50**



No. 475 Wind Indicator. Flashing light type has 8 lamps in circle to indicate wind direction from No. 425. Center lamp flashes wind speed contacts from No. 401. Turn-off switch on panel. Requires 6 volts and 10-conductor cable. **$12.50**

Complete wind set — $57.50
(10-conductor cable available at 20¢ ft.)

Direct Reading Anemometer

No. 410 Wind Speed Indicator. Three-cup anemometer registers wind speed at remote point directly in miles per hour. The 4-inch polished brass dial registers up to 100 mph. Spinning cups generate own current; no external power source required. Will operate remotely up to 200 feet. Complete with 50 feet of cable and small support. **$49.95**

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Weather

No. 111 Maximum-minimum Thermometers. U. S. Weather Bureau type. Set consists of a mercury-filled maximum thermometer with a special constriction for registering highest reading, an alcohol-filled minimum thermometer for registering the lowest reading, and a convenient support. **$22.50**

No. 503 Rain and Snow Gage. U. S. Weather Bureau type. Standard gage has 8-inch brass collector and funnel, inner measuring tube, and copper overflow can, 24 inches overall height. Capacity 20 inches. Red cedar measuring stick **$25.00**

No. 504 Tripod Support for rain gage..... **$15.00**

Weather Bureau Type Instruments

No. 208 Sling Psychrometer. U. S. Weather Bureau type. Two matched thermometers, a wet bulb and a dry bulb, are mounted on a stainless steel backing. Handle and swivel attached for whirling. Range: −20° to +120° F. With psychrometric tables. **$8.80**

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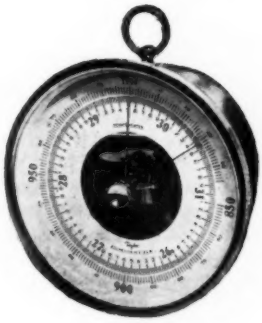

No. 306 Meteorological Barometer. U. S. Weather Bureau type. Brass case has a 5-inch dial graduated in both inches and millibars. Range: 26 to 31.5 inches and 850 to 1060 millibars. Best grade movement, compensated for temperature. For sea-level to 3,000 ft. **$35.00**

No. 307–8 For elevations 2,000–6,000 or 4,900–9,500 ft. **$40.00**

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Astronomy

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No. 731 Celestial Globe. A nine-inch diameter globe has an attractive base and setting that makes it ideal for display in the school-room or home. A dark blue background makes the yellow stars stand out for easy recognition. Stars to the sixth magnitude included. Ecliptic and equator emphasized. Constellation outlines and mythological figures in light blue. Movable meridian for latitude. Brown plastic cradle supplies horizon as well as effective base. With hand book. **$14.50**

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No. 740 Deluxe Celestial Globe. Our finest 16″ globe was designed as a visual aid by teaching astronomers. All stars of the first six magnitudes are shown on a pale blue background, with the first three magnitudes having bright yellow circular backgrounds. Brighter stars named and constellation boundaries indicated. Declination and right ascension circles printed in black. Magellanic clouds and Milky Way stand out in white with other important star clusters indicated. Various models available.

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740-3 Weighted table base, movable meridian..... 57.50
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Astronomy

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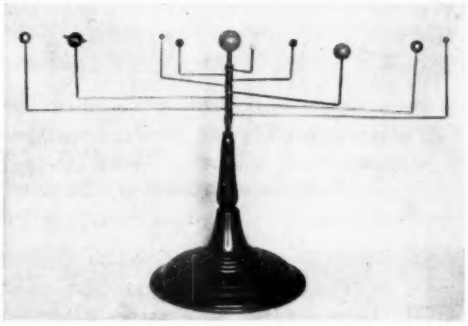
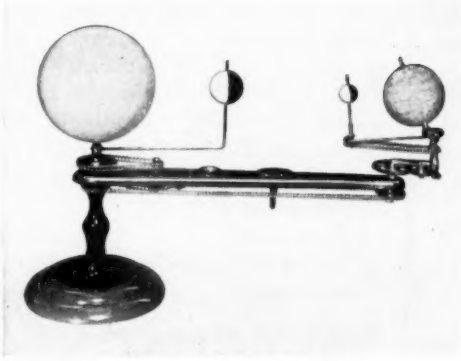
No. 701 Spitz Junior Planetarium. A new visual teaching aid brings a knowledge of the heavens into your classroom or home. A plastic globe is perforated with small apertures and contains a pinpoint light source inside. Stars and constellations are projected on the ceiling; a dome is helpful, but not necessary. Adjustable for date and latitude. Size: 14½″ high, 7½″ square base. Weight 3 lbs. Operates on 110-volts. Complete with 32-page star guide. **$15.00**

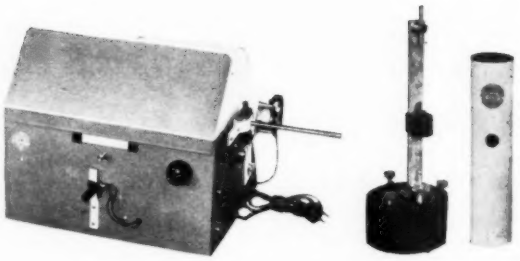


No. 707 Simplified Orrery. A practical demonstration apparatus, depicting the Sun and nine planets, each differently colored and in comparative sizes. Each planet can be moved separately by hand and then the whole apparatus locked in any desired position around the central stem, which carries the model Sun. No moons included. **$37.50**



No. 708 Trippensee Planetarium. This demonstration device shows the relative position and motion of the Sun, Earth, Moon, and planet Venus. Simplifies teaching the rotation of the earth, the annual revolution around the Sun, day and night, change of seasons, and the mechanics of eclipses. This is an orrery-type device and not a projection planetarium. Constructed of brass with chain drive gears. Arm length 16½ inches, overall height 16″. Hand operated. **$75.00**

Seismology



The Series A-R Seismographs were designed by professional seismologists to satisfy a demand for low-cost instruments which would be suitable for routine teleseismic observations by amateurs, as well as for special research projects such as the study of microseisms in meteorology. These seismographs, though simple in construction, are designed to give many years of continuous service. They have been recommended by the Seismographical Society of America to all who wish to gain a first-hand participation in seismic studies.

The seismometer unit consists of a highly sensitive optical lever of the Wood-Anderson type. It has a pendulum mass suspended on a filament, and a mirror is mounted on the front surface of the pendulum mass. Movement of the pendulum mass from earth shocks deflects reflections of a beam of light originating from the recorder unit. Movement of the pendulum mass is dampened by a magnetic clamp according to local requirements.

The recorder unit consists of a light source whose return beam from the seismometer mirror is focused on photographic paper. The paper is attached to a recording drum which is revolved by an electrical motor. Disturbances are indicated by waves on a normally straight recording line. Chart paper should be changed once every 24 hours. After chart paper has been developed, the record of seismic disturbances may be interpreted. Recorder is contained in a steel housing.

SPECIFICATIONS:

Period range	½ sec. to 10 secs.
Damping	Electro-Magnetic
Magnification	500 to 1500 (depending upon period)
Focal length of optical lever	1 meter
Recorder	Photographic
Recorder dimensions	Length 14", Width 11", Height 11½"
Drum speed	25 mm/min.
Record size	30½" x 6"
Power requirement	110 v. 60 cy. AC
Time marks	Must be supplied by extra clock, if desired
Shipping Weight	25 lbs. (approximate)

The complete seismograph must be operated in a dark basement room, but it is not necessary to set the instrument on bed rock. A concrete pier 2 x 4 feet will serve as a satisfactory base. If a dark room is not available, the instrument may be inclosed in a box, provided it is possible to change records in the dark. Installation details and elementary textbook are supplied with each instrument.

Series A-R Seismograph, assembled..... $239.00

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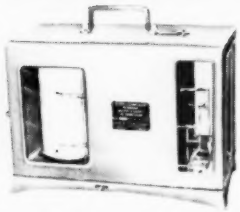

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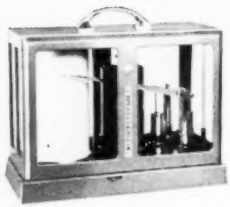

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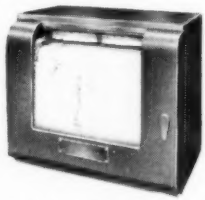

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